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CHAPTER 1

Seeds of Destruction

Destroy the seed of evil, or it will grow up to your ruin.

Aesop

Objectives

The study of this chapter will enable you to:

1. Understand the importance of the biological threat in its context of terrorism and weapons of mass destruction.
2. Discuss the terms *biosecurity* and *biodefense* and relate them to homeland security and defense, respectively.
3. Discuss the reality versus the potential of bioterrorism.
4. Discuss the history of biowarfare and the major events that are important in helping us understand the issues related to using biological substances against an adversary.
5. Understand why many of these threats have been used on a small scale and that going beyond that requires a high degree of technical sophistication and extensive resources.
6. Discuss international and national sentiments toward bioterror scenarios and programs.

INTRODUCTION

The dawning of the 21st century will be characterized as the Age of Terrorism. Terrorism has affected most of us in one way or another. The shocking images of the September 11, 2001, attacks remind us of just how dramatic and devastating terrorism can be. In most developed countries, the concept of bioterrorism and many of the words associated with it are widely recognized. In the United States, *bioterrorism* became a household word in October 2001, when *Bacillus anthracis* (the causative agent of anthrax) spores were introduced into the US Postal Service system by several letters dropped into a mailbox in Trenton, New Jersey (see Fig. 1.1). These letters resulted in 5 deaths from pulmonary anthrax and 17 other cases of inhalation and cutaneous anthrax (Thompson, 2003). In the weeks and months that followed, first responders were called to the scene of thousands of “white powder” incidents that came as a result of numerous hoaxes, mysterious powdery substances, and just plain paranoia (Beecher, 2006). Public health laboratories all over the United States were inundated with samples collected from the scene of these incidents. Testing of postal facilities, US Senate office buildings, and

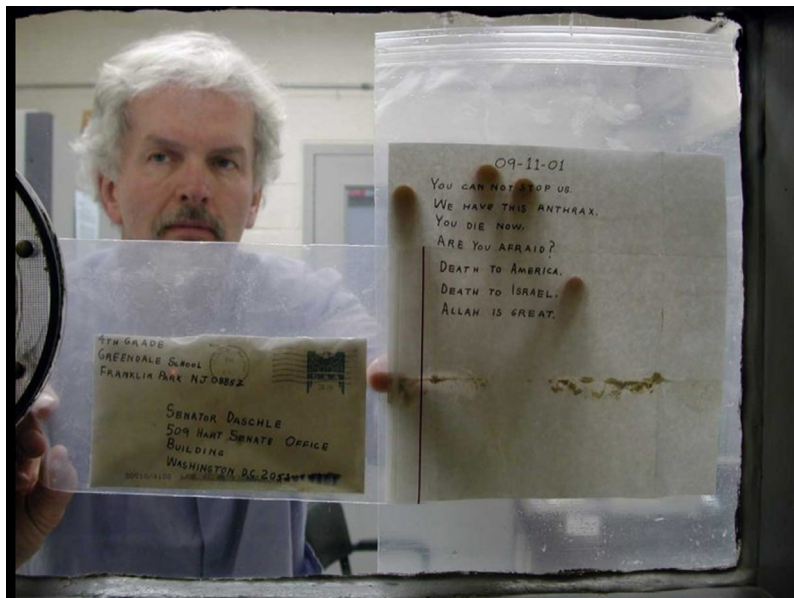


Figure 1.1 This letter, postmarked October 5, 2001, was dropped into a mailbox near Princeton University in Trenton, New Jersey. It was addressed to Senator Tom Daschle with a return address indicating a fourth-grade class from Greendale School in Franklin Park, New Jersey (note that there is no such school). A scientist, Dr. John Ezell, at USAMRIID, Fort Detrick, Maryland, is pictured here holding up the letter and the note it contained. *Courtesy of the FBI.*

news-gathering organizations' offices occurred. Between October and December 2001 the Centers for Disease Control and Prevention (CDC) laboratories successfully and accurately tested more than 125,000 samples, which amounted to more than 1 million separate bioanalytical tests (CDC, 2015). Henceforth there has been a national sense of urgency in preparedness and response activities for a potential act of bioterrorism.

Humankind has been faced with biological threats since we first learned to walk upright. In his thought-provoking book *Guns, Germs and Steel*, Dr. Jared Diamond points out the epidemiological transitions we have faced since we were hunters and gatherers. More than 10,000 years ago the human experience with biological peril was mostly parasitic diseases that only affected individuals. After that, human societies began to herd and domesticate animals. The development of agriculture allowed for population growth and a shift from small tribal bands to a concentration of people into villages. Larger groups of people could stand up to smaller elements, thereby enabling them to successfully compete for resources and better defend the ground that they held. Agriculture also brought some *deadly gifts*: animal diseases that also affected man (**zoonotic diseases**), outbreaks of disease due to massing of people and lack of innate immunity, and a growing reliance on animal protein (Diamond, 1999).

For ages human societies and cultures have been looking for a competitive advantage over their adversaries. Advances in weapons of all types and explosives allowed military

forces to defeat their enemies overtly on the battlefield and covertly behind the lines. Technologies leading to nuclear, biological, and chemical weapons have also been exploited. Indeed, each has been used legitimately and illegitimately on different scales to bring about a change in the tactics, the military situation, or the political will to face an enemy in battle. Biological agents are no exception to this rule. As such, **biowarfare** (biological warfare) has a historical aspect to it that must be considered here because advances in the use of biological agents over the last century are one of the main reasons why bioterrorism exists today.

When President Richard M. Nixon said, in November 1969, that “Mankind already holds in its hands too many of the seeds of its own destruction,” he was signing an Executive Order putting an end to the United States’ offensive capabilities for waging biowarfare. It is arguable that this statement foretold the potential doom we might all face when then state-of-the-art technologies became commonplace techniques in laboratories all over the world today. This chapter accordingly derives its name from the preceding quote and should serve to remind the reader that the seeds we sowed so long ago have now sprouted. The question remains: How shall they be reaped?

THE REALITY VERSUS THE POTENTIAL

Bioterrorism is the intentional use of microorganisms or toxins derived from living organisms to cause death or disease in humans or the animals and plants on which we depend. Biosecurity and biodefense programs exist largely because of the potential devastation that could result from a large-scale act of bioterrorism. Civilian biodefense funding (CBF) reached an all-time high after the anthrax attacks of 2001. Conversely, the reality of the situation is that these well-intended programs cost taxpayers billions of dollars each year. Rapid detection biothreat pathogen tools are available to assist responders with on-site identification of a suspicious substance. In addition, biosecurity and biodefense are “big business” in the private sector. Security measures to protect agriculture and certain vulnerable industries from acts of bioterrorism and natural biological threats are also in place.

Detailed reports published in the journal *Biosecurity and Bioterrorism* ([Schuler, 2005](#); [Lam et al., 2006](#); [Sell and Watson, 2013](#)) show that US government CBF between fiscal year (FY) 2001 and FY2014 amounted to more than \$78 billion. Comparing FY2001 to FY2005, there was an increase in CBF from \$420 million to \$7.6 billion. The Departments of Health and Human Services and Homeland Security, which together account for approximately 88% of the FY2006 request, have remained relatively constant in their funding. Other agencies, most notably the Department of Agriculture and the Environmental Protection Agency, have been more variable. These two agencies saw increased budget requests in FY2006, focusing on programs that protect the nation’s food and water supplies. Civilian biodefense spending, not including special allocations for project BioShield, reached a consistent level of approximately \$6 billion from FY2003 to FY2013

(Sell and Watson, 2013). Refer to Table 1.1 for a summary of the CBF budget for FY2010–14.

BioShield is a program that was designed to give the United States new medical interventions (eg, vaccines, treatments) for diseases caused by several biothreat pathogens. When BioShield was conceived, it cost US taxpayers a total of \$5.6 billion, which was metered out to the Department of Health and Human Services over a 10-year period. Reports surfaced that suggest BioShield funds were being squandered and that few useful products were realized (Fonda, 2006). However, biothreat pathogen research and product development for unusual or rare diseases is fraught with numerous hurdles. This program will be addressed in chapter [Biosecurity Programs and Assets](#).

The US Postal Service spent more than \$800 million developing and deploying its Biohazard Detection System (BDS). At the peak of its utilization, the US Postal Service was spending more than \$70 million each year to operate and maintain the system. The BDS is used only to provide early warning for the presence of a single biothreat pathogen, anthrax. Furthermore, the system screens letter mail that comes from sources such as mailboxes and drops, which accounts for approximately 17% of all letter mail volume (Schmid, 2006). This model program and the technology it uses will be covered extensively in chapter [Consequence Management and a Model Program](#).

All of this seems rather incredible when comparing the level of funding given to one of the greatest biological threats of our time, the human immunodeficiency virus (HIV), which causes AIDS. An estimated 1.8 million people are currently living with HIV in the United States, with approximately 50,000 new infections occurring each

Table 1.1 Civilian biodefense funding (in \$ millions) for US government agencies by fiscal year

Agency/year	FY2010	FY2011	FY2012	FY2013	FY2014
Department of Health and Human Services	4068	4150	3924	3986	4100
Department of Defense	675	789	923	1129	1155
Department of Homeland Security	478	390	335	358	1046
Department of Agriculture	92	84	92	92	94
Environmental Protection Agency	150	128	96	103	102
Department of Commerce	100	103	101	102	112
Department of State	74	74	73	73	68
National Science Foundation	15	15	15	15	15
Department of Veteran Affairs	1	1	1	1	1
Total CBF	5653	5734	5560	5859	6693

FY, fiscal year; CBF, civilian biodefense funding. Amounts are rounded to the nearest whole number.

Data from Sell, T., Watson, M., 2013. Federal agency biodefense funding, FY2013–FY2014. *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 11, 196–216.

year. Currently in the United States, approximately 75% of the new infections in women are transmitted heterosexually. Half of all new infections in the United States occur in people 25 years of age or younger. However, the budget of the National Institutes of Health for AIDS research is approximately \$3 billion per year (NIH, 2015) compared with the \$1.6 billion level of funding it receives for biodefense (Sell and Watson, 2013).

THE HISTORY OF BIOWARFARE

Before delving into the subtleties of biosecurity and biodefense, one should explore the historical aspects of the use of biological agents in warfare and terrorism. The history presented here is not all inclusive. Rather, it is a fair assessment of key events and characterizations that can be examined in other more comprehensive documents.

Pathogens and biological toxins have been used as weapons throughout history. Some would argue that biological warfare began when medieval armies used festering corpses to contaminate water supplies. Over several centuries this evolved into the development of sophisticated biological munitions for battlefield and covert use. These developments parallel advances in microbiology and include the identification of virulent pathogens suitable for aerosol delivery and large-scale fermentation processes to produce large quantities of pathogens and toxins.

However, the history of biological warfare is shrouded by several confounding factors. First, it is difficult to verify alleged or attempted biological attacks. These allegations might have been part of a propaganda campaign, or they may have been due to rumor. Regardless, some of the examples we have been given cannot be supported by microbiological or epidemiologic data. In addition, the incidence of naturally occurring endemic or epidemic diseases during that time complicates the picture so that attribution is impossible (Christopher et al., 1997). More important, our awareness that infectious diseases are caused by microbes does not go back very far in human history. Germ theory, or the fact that infectious diseases are related to and caused by microorganisms, emerged after 1860 through the independent works of Pasteur, Lister, and Koch (Tortora et al., 1995). Therefore how could the attacking or defending commander know that the festering corpses might cause disease when people at that time thought that epidemics were related to “miasmas,” the smell of decomposition, or heavenly “influences”? One need only consider the origin of certain disease names to appreciate this confusion. For instance, malaria gets its name from *malaria*, or “bad air” (ie, swamp gases; Desowitz, 1991). It was not until 1880 that we learned that the etiologic agents of malaria are protozoans in the genus *Plasmodium*. The name *influenza* refers to the ancient belief that the disease was caused by a misalignment of the stars because of some unknown supernatural or cosmic influence (Latin *influentia*). It was not until 1933 that we learned the flu was caused by the influenza virus (Potter, 2001).

Regardless of the lack of awareness of germs at the time, a few of the historic reports about the use of biological weapons in battle are worth noting here:

- In the 6th century BC, Assyrians poisoned enemy wells with rye ergot, a fungus.
- In the 4th century BC, Scythian archers tipped their arrows with blood, manure, and tissues from decomposing bodies.
- In AD 1340, attackers hurled dead horses and other animals by catapult at the castle of Thun L'Eveque in Hainault (northern France). Castle defenders reported that "the stink and the air were so abominable...they could not long endure" and negotiated a truce.
- In AD 1422 at Karlstein in Bohemia, attacking forces launched the decaying cadavers of men killed in battle over the castle walls. They also stockpiled animal manure in the hope of spreading illness. However, the defense held fast, and the siege was abandoned after 5 months. Russian troops may have used the same tactic using the corpses of plague victims against the Swedes in 1710.
- In AD 1495 the Spanish contaminated French wine with the blood of lepers.
- In the mid-1600s a Polish military general reportedly put saliva from rabid dogs into hollow artillery spheres for use against his enemies.
- Francisco Pizarro reportedly gave smallpox virus-contaminated clothing to South American natives in the 15th century.
- In a letter dated July 16, 1763, General Jeffrey Amherst, a British officer, approved the plan to spread smallpox to Delaware Indians ([Robertson, 2001](#)). Amherst suggested the deliberate use of smallpox to "reduce" Native American tribes hostile to the British ([Parkman, 1901](#)). An outbreak of smallpox at Fort Pitt resulted in the generation of smallpox-contaminated materials and an opportunity to carry out Amherst's plan. On June 24, 1763, one of Amherst's subordinates gave blankets and a handkerchief from the smallpox hospital to the Native Americans and recorded in his journal, "I hope it will have the desired effect" ([Sipe, 1929](#)).
- The same tactic was used during the Civil War by Dr. Luke Blackburn, the future governor of Kentucky. Dr. Blackburn infected clothing with smallpox and yellow fever virus, which he then sold to Union troops. One Union officer's obituary stated that he died of smallpox contracted from his infected clothing ([Guillemin, 2006](#)).

As previously mentioned, scientists discovered microorganisms and made advances toward understanding that a specific agent causes a specific disease, that some are food-borne or waterborne, that an agent can cycle through more than one species, and that insects and ticks are the vectors of disease. Furthermore, medical professionals established that wars, famines, and poverty opened populations to the risk of epidemics. Once these links were established, we learned that we could apply control and intervention methods. Scientific knowledge about disease transmission coupled with social stability and active public health campaigns aided human survival. It subsequently became possible for advanced populations to protect their citizens from the burden of some of the most insidious infectious diseases, such as plague, cholera, diphtheria, smallpox, influenza, and

malaria. These epidemics swept across nations in previous centuries, hitting hardest in crowded urban centers and affecting mostly the poor (Guillemin, 2006).

At the opening of the Industrial Revolution, public health in cities had improved, water and food sources were monitored by the state, and vaccines and drug therapies were being invented as further protection. With many childhood diseases conquered, more people were living longer, and they were now dying of more “civilized” diseases such as cancer, heart disease, and stroke (Diamond, 1999). In underdeveloped nations, public health did not develop; hence, epidemics were prevalent and continued to be devastating. The dichotomy between developed and developing nations remains marked by generally good health versus widespread, preventable epidemics (Guillemin, 2006).

As Western nations were taking advantage of innovations in public health and medicine to mitigate epidemics, their governments invented biological weapons as a means of achieving advantage in warfare (Diamond, 1999). The German military has the dubious honor of being the first example of using biological weapons following a state-sponsored program. However, during World War I, they used disease-causing organisms against animals, not people. The goal of their program was to interrupt the flow of supplies to the Allied frontlines. To do this they targeted the packhorses and mules shipped from Norway, Spain, Romania, and the United States. In 1915, Dr. Anton Dilger, a German-American physician, developed a microbiology facility in Washington, DC. Dilger produced large quantities of anthrax and glanders bacteria using seed cultures provided by the imperial German government. At the loading docks, German agents inoculated more than 3000 animals that were destined for the Allied Forces in Europe (Wheelis, 1999). From the German perspective, these attacks violated no international law. In addition, these activities were dwarfed by the atrocities of chemical warfare that was being waged on both sides of the line.

To counter the German threat and explore the potential of air warfare the French sought to improve their integration of aerosols and bombs. At the same time as the French were signing the 1925 Geneva Protocol, they were developing a biological warfare program to complement the one they had established for chemical weapons during World War I (Rosebury and Kabat, 1947). After World War I the Japanese formed a “special weapons” section within their army. The section was designated Unit 731. The unit’s leaders set out to exploit chemical and biological agents. In 1936 they expanded their territory into Manchuria, which made available “an endless supply of human experiment materials” (prisoners of war) for Unit 731. Biological weapon experiments in Harbin, Manchuria, directed by Japanese General Shiro Ishii, continued until 1945. A post-World War II autopsy investigation of 1000 victims revealed that most were exposed to aerosolized anthrax. More than 3000 prisoners and Chinese nationals may have died in Unit 731 facilities. In 1939 the Japanese military poisoned Soviet water sources with intestinal typhoid bacteria at the former Mongolian border. During an infamous biowarfare attack in 1941, the Japanese military released millions of plague-infected fleas from airplanes over villages in China and Manchuria, resulting in several plague outbreaks in those villages. The Japanese

program had stockpiled 400 kg of anthrax to be used in specially designed fragmentation bombs.

In 1942, shortly before the battle of Stalingrad, on the German–Soviet front, a large outbreak of tularemia occurred. Several thousand Soviets and Germans contracted the illness. Some estimate that more than 70% of the victims had inhalation tularemia, which is rare and considered to be evidence of an intentional release. It was determined later that the Soviets had developed a tularemia weapon the prior year ([Alibek and Handelman, 2000](#)).

During World War II the Allies had great fear of German and Japanese biological weapons programs. Their fears were sparked by sketchy reports that the Japanese had an ongoing effort, and British intelligence suggested that Germany might soon target Britain with a bomb packed with biological agents. On the basis of these fears, Great Britain began its own bioweapons program and urged officials in the United States to create a large-scale biological warfare program.

On December 9, 1942, the US government convened a secret meeting at the National Academy of Sciences in Washington, DC. The meeting was called to respond to Great Britain's request. Army officers had urgent questions for an elite group of scientists. Only a few months before, the President of the United States had grappled with the issue of biological weapons. President Franklin D. Roosevelt stated that "I have been loath to believe that any nation, even our present enemies, would be willing to loose upon mankind such terrible and inhumane weapons." Secretary of War, General Henry Stimson, thought differently: "Biological warfare is...dirty business," he wrote to Roosevelt, "but...I think we must be prepared."

President Roosevelt approved the launch of the United States' biological warfare program. For the first time US researchers would be trying to make weapons from the deadliest germs known to science. In spring 1943 the United States initiated its bioweapons program at Camp Detrick (now Fort Detrick), Maryland. The program focused primarily on the use of the agents that cause anthrax, botulism, plague, tularemia, Q fever, Venezuelan equine encephalitis, and brucellosis. Production of these agents occurred at Camp Detrick, Maryland, and other sites in Arkansas, Colorado, and Indiana. The British had made two primary requests of us: (1) to mass produce anthrax spores so that they could be placed in bomblets and stored for later deployment against the Germans in retaliation for any future strike and (2) the British supplied us with the recipe to make botulinum toxin and wanted to see if we could mass produce it. Naturally the entire program was wrapped in a cloak of secrecy. [Fig. 1.2](#) is a collage of some important facilities built at Camp Detrick to produce and test bioweapons formulations.

The British program focused on the use of *B. anthracis* (anthrax) spores and their viability and dissemination when delivered with a conventional bomb. Gruinard Island, off of the coast of Scotland, was used as the testing site for formulations. At the time British scientists believed that the testing site was far enough from the coast to not cause any contamination of the mainland. However, in 1943 there was an outbreak of anthrax in sheep and cattle on the coast of Scotland that faced Gruinard. As a result, the British

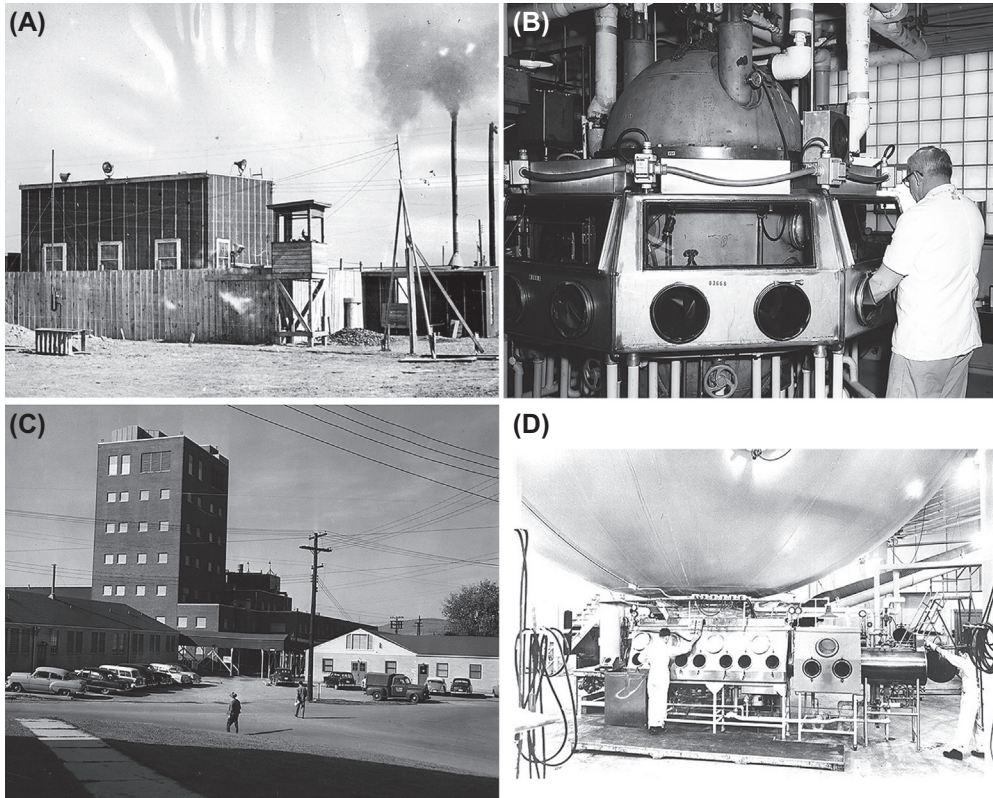


Figure 1.2 (A) The “Black Maria” was the first laboratory facility built at Camp Detrick to conduct top-secret bioweapons research. The purpose of this tarpaper building was to produce Agent X (botulinum toxin) for the British. (B) A Camp Detrick researcher works with an aerobiology chamber to conduct a study with microbial aerosols, a biological weapons formulation. (C) This is the old Pilot Plant (Building 470) at Fort Detrick. Here, experimental formulations of anthrax spores were made. The building had a reputation for mystery. Despite three decontamination procedures, it was never certified 100% clean. (D) Pictured here is a 1,000,000-L metal sphere that workers called the *Eight Ball*. The largest aerobiology chamber ever constructed, it was used to test experimental bioweapons formulations at Fort Detrick. The last experiment in the Eight Ball was in 1969. *Courtesy of the US Army, Fort Detrick.*

decided to stop the anthrax testing and close down the island site. Despite the cessation of experiments, the island remained contaminated for decades until a deliberate and extensive decontamination program rendered the island inhabitable again.

The US bioweapons program continued to grow in scope and sophistication. Much of this was prompted by fear of a new enemy: the threat of communism, the Soviet Union, and its allies. Experiments to test bioweapons formulations were routinely performed on a small scale with research animals. However, more comprehensive field and laboratory studies were performed with human research volunteers exposed to actual live agents and some situational scenarios using surrogate nonpathogenic bacteria to simulate the release of actual pathogens inside of buildings or aimed at cities.

In 1949 researchers from Detrick visited the Pentagon on a secret mission. Disguised as maintenance workers, they released noninfectious bacteria into the duct work of the building to assess the vulnerability of people inside large buildings to a bioweapons attack. The Pentagon trial was considered to be a success because it revealed that germs could be formulated and released effectively for a small-scale act of sabotage. However, there was considerable doubt that biological weapons could be effective against a target the size of a city. Accordingly, several tests were conducted on American cities (Miller et al., 2001). In 1977 the US Army admitted that there were 239 intentional releases of noninfectious bacteria in bioweapons experiments (Cole, 1988). One such trial took place in San Francisco in September 1950, when a US Navy ship sailed a course adjacent to the Golden Gate Bridge to release a plume of seemingly nonpathogenic bacteria (*Serratia marcescens*). This trial was intended to simulate the dispersion of anthrax spores on a large city. On the basis of results from monitoring equipment at 43 locations around the city, the Army determined that San Francisco had received enough of a dose for nearly all of the city's 800,000 residents to inhale at least 5000 of the particles. Although the researchers believed that what they were releasing was harmless, one report shows that 11 people reported to area hospitals with severe infections because of the release of this agent, 1 of which was fatal (Cole, 1988).

Three years later, bioweapons experts took their secret exercises to St. Louis and Minneapolis, two cities that resembled potential Soviet targets, where sprayers hidden in cars dispersed invisible clouds of harmless *Bacillus* spores. In 1966 nonpathogenic *Bacillus globigii* spores were released into the New York subway system using a broken light bulb to demonstrate the ability of a specific formulation to make its way from a central point source to both ends of the system in less than an hour. Revelations of these experiments became known in 1977 when a Senate Subcommittee panel heard testimony from Pentagon officials (US Department of the Army, DTIC B193427 L, 1977). Until that point, neither US citizens nor their representatives in Washington knew anything about the American germ program.

After nearly 3 decades of secret research aimed at producing the ultimate biological weapons and stockpiling them for use against our enemies, President Richard Nixon surprised the world by signing an executive order that stopped all offensive biological agent and toxin weapon research and ordered all stockpiles of biological agents and munitions from the US program be destroyed. Accordingly, on November 25, 1969, he uttered these historic words in a speech to the nation on

...Biological warfare—which is commonly called “germ warfare.” This has massive unpredictable and potentially uncontrollable consequences. It may produce global epidemics and profoundly affect the health of future generations. Therefore, I have decided that the United States of America will renounce the use of any form of deadly biological weapons that either kill or incapacitate. Mankind already carries in its own hands too many of the seeds of its own destruction.

Subsequently, in 1972 the United States and many other countries were signatories to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, commonly called the Biological Weapons Convention. This treaty prohibits the stockpiling of biological agents for offensive military purposes and forbids research into offensive use of biological agents.

Although the former Soviet Union was a signatory to the Biological Weapons Convention, its development of biological weapons intensified dramatically after the accord and continued well into the 1990s. In late April 1979, an outbreak of pulmonary anthrax occurred in Sverdlovsk (now Yekaterinburg) in the former Soviet Union. Soviet officials explained that the outbreak was due to ingestion of infected meat. However, it was later discovered that the cause was from an accidental release of anthrax in aerosol form from the Soviet Military Compound 19, a Soviet bioweapons facility. (This event is examined thoroughly in chapter [Case Studies](#) as a case study to demonstrate the potential of weaponized anthrax.) The robust bioweapons program of the Soviet Union employed more than 60,000 people. Building 15 at Koltsovo was capable of manufacturing tons of smallpox virus each year. In Kirov, the Soviets maintained an arsenal of 20 tons of weaponized plague bacterium. By 1987 Soviet anthrax production capacity reached nearly 5000 tons a year.

In the later part of the 1990s the Russians disassembled their awesome bioweapons production capacity and reportedly destroyed their stocks. As the Soviet Union dissolved, it appeared that the threat of biowarfare would diminish. However, the Age of Bioterrorism emerged with the anthrax attacks of 2001. In addition, the US Department of State published a report in 2004 that affirmed that six countries had active bioweapons programs. [Table 1.2](#) summarizes some of these events.

MODERN-DAY BIOTERRORISM

Biodefense programs and initiatives come out of a sense of vulnerability to biowarfare potentials. Bioterrorism is deeply founded in what has been gained from active biowarfare programs ([Miller et al., 2001](#)). In the early 1970s the leftist terrorist group, the Weather Underground, reportedly attempted to blackmail an Army officer at Fort Detrick working in the Research Institute of Infectious Diseases (USAMRIID). The group's goal was to get him to supply organisms that would be used to contaminate municipal water supplies in the United States. The plot was discovered when the officer attempted to acquire several items that were "unrelated to his work." Several other attempts are worth mentioning here:

- In 1972 members of the right-wing group Order of the Rising Sun were found in possession of 30–40 kg of typhoid bacteria cultures that were allegedly to be used to contaminate the water supplies of several Midwestern cities.

Table 1.2 Seminal moments in the history of biowarfare and bioterrorism. Some data in this table taken from [Eitzen and Takafuji, 1997](#)

Date	Event	Significance
6th century, BC	Assyrians poisoned enemy wells with rye ergot.	First known use of a biological toxin.
1763	British soldiers give blankets infected with the smallpox virus to American Indians.	Notable and documented use of virus against combatants.
1915	Anton Dilger produces anthrax and glanders bacterium to infect horses intended for the warfront.	Notable and documented use of bacteria against animals.
June 17, 1925	Delegates in Switzerland create a Geneva Protocol banning the use of chemical and bacteriological methods of warfare.	First international effort to limit use of biologicals in warfare.
1932	The Japanese army gives General Ishii control of three biological research centers, including one in Manchuria.	Most despicable character in bioweapons history gets his start.
1934	Great Britain begins taking steps toward establishing its own biological weapons research project.	Allies start to develop a program.
July 15, 1942	Anthrax tested on Gruinard Island against sheep.	Allies' first field test of bioweapon.
November 1942	British implore the United States to lead bioweapons production efforts; negotiations commence and President Roosevelt approves the program.	Beginning of US bioweapons program.
Spring 1943	US bioweapons program begins its activities at Camp Detrick, Maryland.	Implementation of plans to begin US bioweapons program.
May 1949	The US Army Chemical Corps sets up a Special Operations Division at Camp Detrick to perform field tests with bioweapons formulations.	Tests conducted at the Pentagon show that biological weapons formulations are feasible for sabotage.
1950	Navy warships spray the cities of Norfolk, Hampton, Newport News, and San Francisco.	Tests show that large-scale deployment of a bioweapon from the sea is feasible.
1953	Conduct of the St. Jo Program stages mock anthrax attacks on St. Louis, Minneapolis, and Winnipeg using aerosol generators placed on top of cars.	Tests show that large-scale deployment of a bioweapon from the land is feasible.
1955	Operation Whitecoat uses human research volunteers to study the effects of biological agents on human volunteers.	The operation will continue for the next 18 years and involve some 2200 people.

Table 1.2 Seminal moments in the history of biowarfare and bioterrorism—cont'd

Date	Event	Significance
1957	Operation Large Area Concept kicks off to test the release of aerosols from airplanes; the first experiment involves a swath from South Dakota to Minnesota and further tests cover areas from Ohio to Texas and Michigan to Kansas.	Tests show that large-scale deployment of a bioweapon from the air is feasible; some of the test particles travel 1200 miles.
November 25, 1969	Nixon announces that the United States will renounce the use of any form of deadly biological weapons that either kill or incapacitate.	The end of an era in US offensive biological weapons research, production, and storage.
April 10, 1972	The Biological Weapons Convention, which bans all bioweapons, is completed and opened for signature.	Seventy-nine nations signed the treaty, including the Soviet Union.
March 26, 1975	The Biological Weapons Convention officially goes into force; the US Senate also finally ratifies the 1925 Geneva Protocol.	Political will to ban biological weapons on the international front.
April 1979	Nearly 70 people die from an accidental release of anthrax spores in the Soviet city of Sverdlovsk.	The United States suspects that anthrax bacterial spores were accidentally released from a Soviet military biological facility.
1984	The Rajneeshees contaminate food with <i>Salmonella</i> bacterium in a small town in Oregon to influence local elections.	The first significant act of bioterrorism in the United States.
1989	A Soviet defector from Biopreparat, Vladimir Pasechnik, reveals the existence of a continuing offensive biological weapons program in the Soviet Union.	Evidence that the Soviet Union is violating the Biological Weapons Convention.
April 1992	Russian president Boris Yeltsin admits the 1979 outbreak was caused by the Soviet military but gives few details.	An admonition that the Soviet Union operated an offensive biological warfare program in violation of the Biological Weapons Convention.
Fall 2001	Envelopes filled with anthrax spores are sent to various media and political figures in the United States; 22 people, from Florida to Connecticut, are infected; 5 die.	A national movement begins to prepare a citizenry against the threat of bioterrorism, which has now become a household word.
2003–present	Letters containing ricin have been mailed to public officials from various people and places. Many perpetrators have been caught and convicted. Others remain at large.	These small-scale incidents keep us mindful that some biological agents are easy to acquire and utilize in crimes and small-scale acts of terrorism.

- In 1975 the Symbionese Liberation Army was found in possession of technical manuals on how to produce bioweapons.
- In 1980 a Red Army Faction safe house reportedly discovered in Paris included a laboratory containing quantities of botulinum toxin.
- In 1983 the Federal Bureau of Investigations (FBI) arrested two brothers in the northeastern United States for possession of an ounce of nearly pure ricin.
- In 1984 followers of the Bhagwan Shree Rajneesh contaminated salad bars with *Salmonella* bacteria in a small town in Oregon. It was the largest scale act of bioterrorism in US history. More than 750 cases of salmonellosis resulted from the salad bar contamination. It was later discovered that the Rajneeshees wanted to influence the local county elections. Cult members obtained the *Salmonella* strain through the mail from American Type Culture Collection and propagated the liquid cultures in their compound's medical clinic.
- In 1989 a home laboratory producing botulinum toxin was discovered in Paris. This laboratory was linked to a cell of the German-based Bäder Meinhof Gang.
- In Minnesota, four members of the Patriots Council, an antigovernment extremist group, were arrested in 1991 for plotting to kill a US marshal with ricin. The group planned to mix the homemade ricin with a chemical that speeds absorption (dimethylsulfoxide) and then smear it on the door handles of the marshal's car. The plan was discovered and all four men were arrested and the first to be prosecuted under the US Biological Weapons Anti-Terrorism Act of 1989.
- In 1995 Aum Shinrikyo, a Japanese doomsday cult, became infamous for an act of chemical terrorism when members released sarin gas into the Tokyo subway. What many people do not know about the group is that it developed and attempted to use biological agents (anthrax, Q fever, Ebola virus, and botulinum toxin) on at least 10 other occasions. Despite several releases, it was unsuccessful in its use of biologicals. This program is examined more thoroughly in chapter [Case Studies](#).
- Several small-scale incidents involving the biological poison ricin (refer to [Fig. 1.3](#)) have occurred since the Amerithrax incident. Here are the more notable ones:
 - In 2003 several letters containing ricin were recovered from a mail-sorting center in Greenville, South Carolina. A note from someone calling themselves the "Fallen Angel" accompanied those letters.
 - In 2004 ricin was sent to the office of Senator Bill Frist. Some federal investigators believe that this instance may be tied to the Fallen Angel, but no one has been identified for this biocrime or the 2003 incident.
 - In 2013 ricin was sent to US President Barack Obama and New York City Mayor Michael Bloomberg. A woman from Shreveport, Louisiana, was arrested for this biocrime and later convicted on several charges.
 - Also in 2013 a letter containing ricin was sent to President Barack Obama, Mississippi Senator Roger Wicker, and Mississippi judge Sadie Holland. A Tupelo,

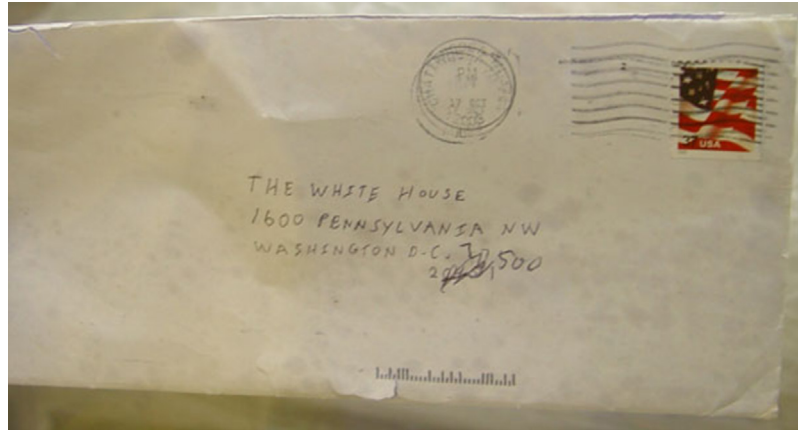


Figure 1.3 A letter addressed to the White House sent in October 2003. The letter contained ricin and a note from the Fallen Angel. *Courtesy of the FBI.*

Mississippi man was convicted of crimes related to these incidents and sentenced to 25 years in prison.

- In 2014 a Philadelphia man sent a romantic rival a scratch-and-sniff birthday card laced with ricin. In 2015 he was convicted on several charges related to the incident and subsequently received a sentence of 20–40 years in prison.

The Public Health Security and Bioterrorism Response Act of 2002

On June 12, 2002, President George W. Bush uttered these remarks from the White House at the signing of HR 3448, the Public Health Security and Bioterrorism Response Act of 2002:

Bioterrorism is a real threat to our country. It's a threat to every nation that loves freedom. Terrorist groups seek biological weapons; we know some rogue states already have them...It's important that we confront these real threats to our country and prepare for future emergencies.

It is clear that September 11 and the anthrax attacks of 2001 sent the country to war and sparked several initiatives against all forms of terrorism.

WEAPONIZATION

Biological agents have some unique characteristics that make weaponizing them attractive to the would-be terrorist. Most biological weapons are made up of living microorganisms, which means that they can replicate once disseminated. This possibility amplifies the problem and the effect of the weapon in several ways. First, some agents are capable of surviving in various different hosts. The target might be humans, but the disease may manifest in other animal hosts, such as companion

animals (pets). In doing so, the problem may be more difficult to control. Second, when people become infected with a disease-causing organism, there is an incubation period before signs of illness are apparent. During this incubation period and the periods of illness and recovery, the pathogen may be shed from the victim, causing the contagion to spread (a possibility only with diseases that are transmitted from person to person). There is no rule of thumb for how many people might be infected from a single patient. However, the nature of contagion clearly compounds the problem well beyond the initial release of the agent. In this instance the initial victims from the intentional outbreak become more weapons for the perpetrator, spreading the problem with every step they take. As Grigg et al. (2006) stated so precisely in their paper, “when the threat comes from the infected population, self-defense becomes self-mutilation.” The would-be terrorist could surely derive great pleasure from watching government officials and responders tread on the civil liberties of such victims as they attempt to limit the problem from spreading among the population.

Making an effective biological weapon is no easy undertaking. The process and complexity depends largely on the pathogen selected to be “weaponized.” If the pathogen is a spore-forming bacteria, such as *B. anthracis* (the causative agent of anthrax), there are five essential steps: germination, vegetation, sporulation, separation, and weaponization. The first three steps are designed to get small quantities of seed stock to propagate into a starter culture, grow them to a significant stage of growth in the proper volume, and turn those active cells into spores. The goal of the last two steps is to separate the spores from the dead vegetative cells and spent media. All five steps have dozens of secondary steps. In addition, each of the five steps requires a fairly sophisticated and well-equipped laboratory if the goal is to develop a sizable quantity of refined materials.

Weaponization is a term that applies to the processes necessary to purify, properly size, stabilize, and make biological agents ideally suited for dissemination. Stabilization and dissemination are important issues because of the susceptibility of the biological agents to environmental degradation, not only in storage but also in application. These issues are problems whether the end use is for biological weapons, pharmaceuticals, cosmetics, pesticides, or food-related purposes. The susceptibility of the organisms to inactivation by the environment varies with the agent. As an example, anthrax spores released into the environment may remain viable for decades, whereas plague bacterium may survive for only a few hours. Loss of viability or bioactivity is likely to result from exposure to physical and chemical stressors, such as exposure to ultraviolet radiation (sunlight), high surface area at air–water interfaces (frothing), extreme temperature or pressure, high salt concentration, dilution, or exposure to specific inactivating agents. This requirement of stabilization also extends to the methods of delivery because the organisms are very susceptible to degradation in the environments associated with delivery systems.

The primary means of stabilization for storage or packaging are concentration; freeze drying (lyophilization); spray drying; formulation into a stabilizing solid, liquid, or gaseous solution; and deep freezing. Methods of concentration include vacuum filtration, ultrafiltration, precipitation, and centrifugation. Freeze drying is the preferred method for long-term storage of bacterial cultures because freeze-dried cultures can be easily dehydrated and cultured via conventional means. Freeze-dried cultures may remain viable for more than 30 years. Deep freezing of biological products is another long-term storage technique for species and materials not amenable to freeze drying. The method involves storage of the contained products in liquid nitrogen freezers ($-196^{\circ}\text{C}/-325^{\circ}\text{F}$) or ultralow-temperature mechanical freezers ($-70^{\circ}\text{C}/-94^{\circ}\text{F}$).

Culturing viruses is a more costly and tenuous process because host cells are required for viral propagation. This means that cultures of host cells must be kept alive, often in an oxygen-deficient and temperature-stable atmosphere. In some cases, viruses may be more fragile when deployed as weapons, some becoming inactive on drying. Biological toxins can be difficult to produce and purify, each requiring its own special set of circumstances. Two specific examples are covered in subsequent chapters when those agents are discussed in detail. However, past bioweapons programs have determined that these agents are most effective when prepared as a freeze-dried powder and encapsulated.

A QUESTION OF SCALE

Biological attacks by a terrorist group are apparently not easy to conduct or a practical option. If they were easy or practical, then many terrorist groups and hostile states would have done so long ago and frequently. Our experience today with acts of biological terrorism has to do mainly with small-scale, limited attacks. However, if one were to acquire the means to produce the weapons, as described here, or purchase viable, sophisticated materials on the black market, a small group of persons could bring about the infection of a large percentage of targeted persons. Clinical illness could develop within a day of dispersal and last for as long as 2–3 weeks. In a civil situation, major subway systems in a densely populated urban area could be targeted for a biological agent strike, resulting in massive political and social disorganization. It would take little weaponized material to bring about the desired effect. Looking at this potential comparatively on a weight-to-weight basis, approximately 10 g of *B. anthracis* (anthrax) spores could kill as many people as a ton of the nerve agent sarin.

With bioweapons in hand, small countries or terrorist groups might develop the capability to deliver small quantities of agents to a specific target. Under appropriate weather conditions and with an aerosol generator delivering 1- to 10- μm particle-sized droplets, a single aircraft could disperse 100 kg (220 lb) of anthrax over a 300- km^2 area (74,000 acres) and theoretically cause 3 million deaths in a population density of 10,000 people/ km^2 (US DOD, ADA 330102, 1998).

Much has been made of the potential of aerosolized powders and respiratory droplets in factual and fictitious biothreat scenarios. The largest infectious disease outbreak in the history of the United States occurred in April 1993. The event was caused by an accidental waterborne contamination. The outbreak of cryptosporidiosis, which occurred in the greater Milwaukee area, was estimated to have caused more than 430,000 people to become ill with gastroenteritis among a population of 1.6 million (MacKenzie et al., 1994). Approximately 4400 people were hospitalized and about 100 people died as a result of the outbreak. The Milwaukee outbreak was attributed to failure of filtration processes at one of the two water treatment plants that served the city. Several deficiencies were found at the plant, including problems relating to a change in the type of water treatment chemicals used for coagulation of contaminants before the filtration step. Weather conditions at the time were unusual, with a heavy spring snowmelt leading to high source water turbidity and wind patterns that may have changed normal flow patterns in Lake Michigan, the raw water source for the city.

Critical Thinking

Describe the fundamental difference between biodefense and biosecurity.

THE GENESIS OF BIOSECURITY AND BIODEFENSE

The secrecy of bioweapons programs of the previous century has been uncloaked. Some of the most insidious disease agents ever to afflict humans, animals, and plants have been mass produced and perfected for maximum effectiveness. Terrorist groups and rogue states may be seeking to develop bioweapons capabilities. These significant developments in bioweapons gave military leaders and politicians cause for great concern over the past few decades. The military necessity to protect the force and defend the homeland is the goal of a good biodefense program. Simply put, **biodefense** is the need for improved national defenses against biological attacks. These are national programs, mostly planned and carried out by military forces and other government agencies. Initially, biodefense programs require an intelligence-gathering capability that strives to determine what may be in the biological weapons arsenal of an aggressor. Intelligence is needed to guide biodefense research and development efforts aimed at producing and testing effective countermeasures (ie, vaccines, therapeutic drugs, and detection methods). In addition, a real-time reporting system should be developed so that officials can be informed about an emerging threat before an agent has a chance to affect armed forces and millions of people in the homeland. The development of integrated systems for detecting and monitoring biological agents is instrumental to this goal. Although most biodefense initiatives rest with the military, civilian government agencies contribute greatly to the biodefense posture. This is evident by the

increases in CBF over the past few years and will be discussed in great detail in Part IV of this book. On the other hand, **biosecurity** refers to the policies and measures taken for protecting a nation's food supply and agricultural resources from accidental contamination and deliberate attacks of bioterrorism.

BIOLOGICAL THREATS TODAY AND IN THE FUTURE

As I sit here today writing the second edition of this book, I am reflecting on the most recent concerns that we have for biological threats in modern society. For what it is worth, we seem to be much less concerned about acts of bioterrorism and/or biowarfare than we were 10–50 years ago. Instead I see a great deal of concern, and rightfully so, for emerging infectious diseases and reemerging biological threats. We are also keenly aware of the accidental release of biological agents from research and reference laboratories. To illustrate these points we will briefly discuss four items of international interest that have been emphasized in the media: accidental shipment of live anthrax-positive controls samples, the 2014/2015 Ebola outbreak in West Africa, cases of Middle East respiratory syndrome coronavirus (MERS-CoV) in South Korea and Saudi Arabia, and a massive outbreak of highly pathogenic avian influenza (HPAI).

Laboratory Mishaps

As previously mentioned, concerns for biological threat led to a wellspring of funding (nearly \$80 billion in 15 years) for civilian biodefense programs in the United States. With all of this money the United States was able to build tremendous capabilities to detect and diagnose the agents and the diseases, respectively. With this money a few medical countermeasures (vaccines and treatments) were developed and produced. Centers of Excellence were funded and highly secure containment (biosafety level 4) laboratories were built. With these new programs, testing modalities, and laboratories came the need to provide a ready supply of positive control agents and contracting opportunities for private biotechnology firms. As one very recent example, the US Army laboratory in Dugway Proving Grounds, Utah, provided positive control samples of anthrax (*B. anthracis*) spores to public and private laboratories. Before shipment, the spores had been propagated in the Army laboratory and were exposed to gamma radiation to ensure no living spores were in the vials being provided. Upon receipt of the samples, one laboratory in Maryland questioned the integrity of the contents of the vial they received because there was no “death certificate” accompanying the samples. Out of an abundance of caution they removed a small portion of the vial and streaked it onto sheep blood agar plates. To their amazement, several days later the plates showed growth and tested positive for anthrax. They immediately notified the CDC and the Army. The CDC initiated an investigation and notified the media of the incident. The investigation showed that the living anthrax samples had been shipped to 69 laboratories in 19 US

states and 5 other countries ([USA Today, 2015](#)). Once again the seeds of our destruction are sprouting, and some are of the opinion that we are our own worst enemy.

More than 1100 laboratory incidents involving potential bioterror germs were reported to federal regulators during 2008 through 2012.

USA Today (2014)

Ebola

Ebola virus was first discovered in 1976 in the Sudan and Zaire. Ebola virus exists naturally in fruit bats, with sylvatic transmission to other mammals and sometimes humans when they consume raw or undercooked meat from an infected animal. Infection with Ebola virus in humans leads to severe viral hemorrhagic fever (VHF), which is often fatal ([CDC, 2015](#)). In March 2014 an outbreak of Ebola virus disease (EVD) began in Guinea, a Western African nation. Public health agencies at all levels failed to react quickly to the outbreak and it quickly spread to urban areas in Liberia and Sierra Leone. Subsequently, EVD spread to Nigeria and Senegal. International air travel brought EVD to the United States and Europe, although the number of cases was very small and the threat was stamped out with ample infection control procedures in health-care facilities and aggressive public health measures for those exposed to actual case patients ([CDC, 2015](#)). This is the largest outbreak of EVD in history. At the time of this writing, the outbreak has been quelled by a “better late than never” effort. Volunteers and medical relief groups from the United States and other countries received special training and deployed to West Africa to help identify cases and treat the victims (see [Fig. 1.4](#)). However, new cases continue to be reported from Guinea and Sierra Leone. As of June 26, 2015, there have been 16,801 EVD cases (suspect, probable, and confirmed) worldwide with approximately 6411 deaths; this equates to a 38% mortality rate ([WHO, 2015a](#)).

To most the threat of Ebola virus remains distant and out of mind. However, the stark reality is that international travel can interject EVD into any populace on any continent within a matter of days. No country, person, or organization is immune to this threat. What makes EVD such a great concern? First, Ebola virus is a US Health and Human Services Category A agent. It meets all of the criteria for such a designation. EVD results in high morbidity and mortality. EVD requires special preparedness measures for public health and health care. EVD is spread from person to person. EVD can lead to panic and social disruption ([CDC, 2015](#)). With this outbreak in particular, we are seeing all four criteria fulfilled. To make things worse, there is no Food and Drug Administration (FDA)-approved vaccine for humans and no FDA-approved drug for treating VHF case patients. In a health-care setting, EVD patients receive supportive care (hydration therapy) and rarely experimental drugs ([CDC, 2015](#)). Perhaps the only good thing to come



Figure 1.4 This image shows two students in the CDC's Ebola Treatment Unit training course for health-care workers (2014). The program had been designed to educate participants who would be deployed as members of the West African Ebola Response team as to the proper protocols to be followed when treating EVD patients. The two participants were displaying the personal protective equipment worn by treatment specialists who would be interacting with EVD patients. *Courtesy of the CDC/Nahid Bhadelia, MD.*

from this outbreak is the development of a vaccine for Ebola virus. There are currently three vaccine candidates undergoing Phase III clinical trials in West Africa ([WHO, 2015b](#)). A case study on this outbreak is offered in chapter [Case Studies](#) of this book.

Critical Thinking

How have international and national attitudes toward the biological threat changed since the early post-9/11 era? Include some discussion about the reality of versus the potential for biological threats.

MIDDLE EAST RESPIRATORY SYNDROME CORONAVIRUS

MERS-CoV (see [Fig. 1.5](#)) was recognized by the World Health Organization (WHO) as a newly emerging pathogen in 2012 ([Berry et al., 2015](#)). The initial case where virus isolation and characterization came from occurred in Jeddah, Saudi Arabia. Subsequent infections were reported in Middle Eastern countries (Jordan, Qatar, and the United Arab Emirates), with a few cases also identified in Europe, North Africa, and the United States. MERS-CoV leads to severe respiratory illness in susceptible patients and is spread through person-to-person contact.

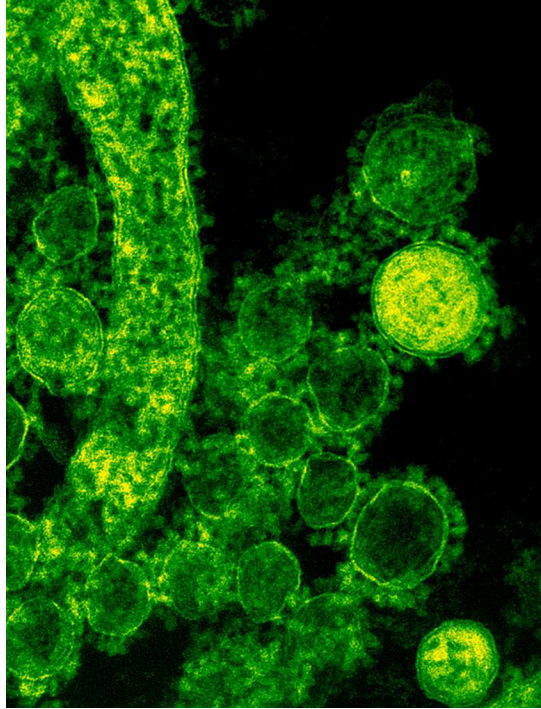


Figure 1.5 This is a highly magnified, digitally colorized transmission electron micrograph of the MERS-CoV virus. *Courtesy of the National Institute of Allergy and Infectious Diseases.*

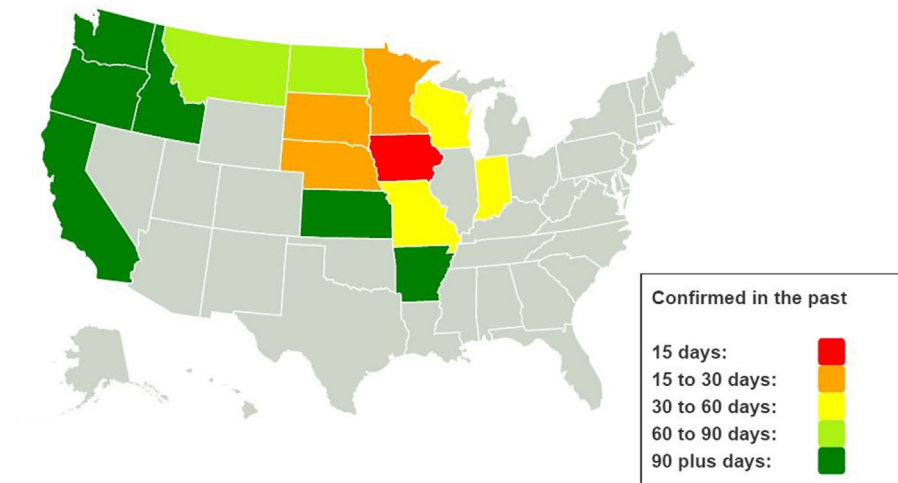
South Korea has recently been the epicenter of the largest outbreak of MERS-CoV outside of the Middle East, reporting 180 cases and 29 deaths ([WHO, 2015c](#)). The outbreak in South Korea was traced to a single infected traveler. Once again, this demonstrates the vulnerability to unexpected outbreaks of unusual diseases that all countries share in this highly mobile world. A report from a joint WHO–South Korean investigation of this outbreak identified several reasons for the severity of the outbreak in South Korea. These include a lack of awareness among health-care workers and the general public about MERS-CoV, the practice of “doctor shopping” (seeking care at multiple hospitals), people visiting infected patients in multibed hospital rooms, substandard infection control and prevention measures in health-care facilities, and contact of infected MERS-CoV patients in crowded emergency rooms. Nearly all of the country’s confirmed MERS-CoV patients were infected while seeking care or visiting hospital patients ([Boston Globe, 2015](#)). More about MERS-CoV and other emerging pathogens is in chapter [Category C Diseases and Agents](#).

Avian Influenza

H5N1 has been very much in the news since 1997 when the novel strain H5N1 jumped from domestic bird populations (poultry) to humans in South East Asia ([Ryan, 2008](#)).

Update on Avian Influenza Findings
Poultry Findings Confirmed by USDA's National Veterinary Services Laboratories

As of June, 2015



223 Detections Reported	48,091,293 Birds Affected
12/19/14 First Detection Reported	6/17/15 Last Detection Reported

Figure 1.6 This map of the United States shows the states where there have been cases of HPAI in a recent outbreak. Note that the number of birds that have been affected in a 7-month period exceeds 48 million. *Courtesy of the US Department of Agriculture.*

H5N1 was very much feared by public health and government officials for its pandemic potential. Since 2003 there have only been approximately 650 cases of H5N1 infection in humans, with a mortality rate of approximately 60% ([HHS, 2015](#)). Since that time, numerous other novel strains have emerged. In fact, a novel H1N1 arose out of swine in 2009 and was the cause of a mild pandemic in humans.

More recently, the novel strains H5N2 and H5N8 have been found to be the cause of major morbidity and mortality in poultry operations (chicken and turkey) in the United States, with 223 detections affecting more than 48 million birds ([USDA, 2015](#)). Refer to [Fig. 1.6](#) for a graphic representation of this outbreak. The financial impact on the poultry growers and the egg and meat industry has been enormous. More can be found on this topic in chapter [Recent Animal Disease Outbreaks and Lessons Learned](#).

CONCLUSION

From this first chapter we can now understand and appreciate the scope and importance of biological threats and see where they may be and have become the desire of terrorist groups and the makings of weapons of mass destruction. Biowarfare has a history. The major events are important in helping us understand the issues related to using biological substances against an adversary. We now know the difference between biosecurity and biodefense and can relate them to homeland security and homeland defense, respectively. We also know how expensive these programs are because nearly \$80 billion has been spent on civilian biodefense since FY2001 in the United States alone. As discussed herein, there is a significant difference in the reality and the potential of bioterrorism. Bioterrorism on a large scale is a low-probability event. Bioterrorism and biocrimes on a small scale (eg, small amount of ricin directed at one or a few individuals) are fairly routine occurrences with little potential. Biological threats remain very much in the news. Recent examples, such as laboratory incidents, the Ebola outbreak of 2014/2015, the outbreak of MERS-CoV in South Korea, and the HPAI outbreak affecting poultry in the United States, make us aware that we must remain vigilant and utilize the biosecurity and biodefense programs to help us identify and respond to these accidental exposures and emerging threats.

ESSENTIAL TERMINOLOGY

- **Biodefense.** The collective efforts of a nation aimed at improving defenses against biological attacks. Within these efforts are programs and agencies working toward increasing data collection, analysis, and intelligence gathering. The intelligence is applied to programs aimed at mitigating the effects of bioweapons by developing vaccines, therapeutics, and detection methods to increase the defensive posture. Ultimately, biodefense initiatives protect the military forces and the citizens from the effects of biological attack.
- **Biosecurity.** The policies and measures taken for protecting a nation's food supply and agricultural resources from accidental contamination and deliberate attacks of bioterrorism.
- **Bioterrorism.** The intentional use of microorganisms or toxins derived from living organisms to cause death or disease in humans or the animals and plants on which we depend. Bioterrorism might include such deliberate acts as introducing pests intended to kill US food crops; spreading a virulent disease among animal production facilities; and poisoning water, food, and blood supplies.
- **Biowarfare**, also known as *germ warfare*. The use of any organism (bacteria, virus, or other disease-causing organism) or toxin found in nature as a weapon of war. It is meant to incapacitate or kill an adversary.

- **Pathogen.** A specific causative agent of disease, mostly thought of as being an infectious organism (eg, bacteria, virus, rickettsia, protozoa).
- **Weaponization.** When applied to biologicals, the term implies a process of taking something natural and making it harmful through enhancing the negative characteristics of it. With biological agents, one might weaponize the agent by making more lethal, more stable, and more easily delivered or disseminated against an intended target. There is considerable debate about the use of this term.
- **Zoonotic disease.** An animal disease that may be transmitted to humans.

DISCUSSION QUESTIONS

- How was the decision made to begin the US biological weapons program?
- What are the significant events in the history of biowarfare? What makes them significant?
- When President Nixon said that “Mankind already holds in its hands too many of the seeds of its own destruction” in November 1969, what did he mean by that?
- Weaponizing a biological agent is easy to do, right?
- No one knows exactly who perpetrated the Anthrax attacks of 2001, and there has been no repeat of them since. Why do you think we have seen no repeat of the anthrax attacks since 2001?

WEBSITES

The Center for Arms Control and Nonproliferation has an online course in biosecurity. Type the URL that follows into your Internet browser and click on *View Course* and select *Unit 2: “The History of Biological Weapons.”* The six sections in this unit provide an excellent overview and reinforce the material presented in the subheading about the History of Biowarfare: www.armscontrolcenter.org/resources/biosecurity_course.

The CDC’s Emergency and Preparedness website offers a segmented video short lesson on the history of bioterrorism. The seven sections give a general overview on bioterrorism and separate vignettes on anthrax, plague, tularemia, VHFIs, smallpox, and botulism: www.bt.cdc.gov/training/historyofbt.

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